Accelerator Systems Division Highlights Ending September 24, 2004

ASD/JLAB: Cold Linac

With additional rinsing the final cavity for the electropolished string, H-2, has been qualified.

H-7 and H-8 cryomodule assembly continues on schedule.

Testing of the H-5 cryomodule has been successfully completed.

The H-3 cryomodule was shipped to ORNL.

Cold compressor electrical feedthroughs are installed and the compressors were rotated to confirm functions

ASD/BNL: Ring

ASAC: talks will be presented next week by J. Wei, D. Raparia, T. Russo and C. Pearson. Dry run rehearsals were conducted this week via video conference between OR and BNL.

Diagnostic Production Plan: revision R01 was circulated among principal parties at BNL & Oak Ridge for a final review. Included was a revised delivery schedule for beam-line vacuum hardware and related electronics.

A PCR was submitted to allow BNL to delete $285K of Diagnostics electronics scope and use those funds to cover the incurred increase in magnet steel prices, thereby eliminating the need to cover that increase with contingency funds. The electronics had been declared a low priority by the Diagnostics Advisory Committee in Feb. 2004, and DOE concurred in May.

Injection drawings: our designers are working closely with AP to finalize the injection line design. Recent changes include: chicane #1 (lattice and bumps); extraction dump septum (lattice and bumps); the foil changer mechanism (assembly clearance) and electron absorber (design, size and position). In addition, much effort has been spent on providing modeling, position and aperture information to AP and Survey. Our aim is to have these drawings complete by the end of October.

RTBT drawings: work continues at a slower pace on this lower priority job. Our emphasis currently is on the injection straight section, remaining vacuum hardware, the extraction straight section, the 36Q85's magnet assemblies, collimator/scraper shielding and design room checking. The RTBT / Target interface with the 36Q85's, the lattice at extraction, and the RTBT bending dipole will be done last.

A PO was released this week to purchase steel for the Ring doublet lifting fixtures.

Chicane #1 was moved from the measurements test stand to the mock-up injection string in Building 905.

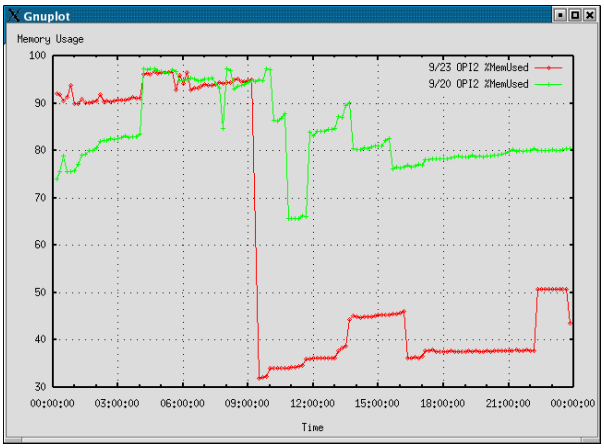
Ken Rust is at IE Power this week for acceptance testing of two 1st article power supplies (900V, 51 & 80V PS).

Pulse Forming Networks (PFN): Applied Power Systems completed testing of PFN unit #13. One more to go!

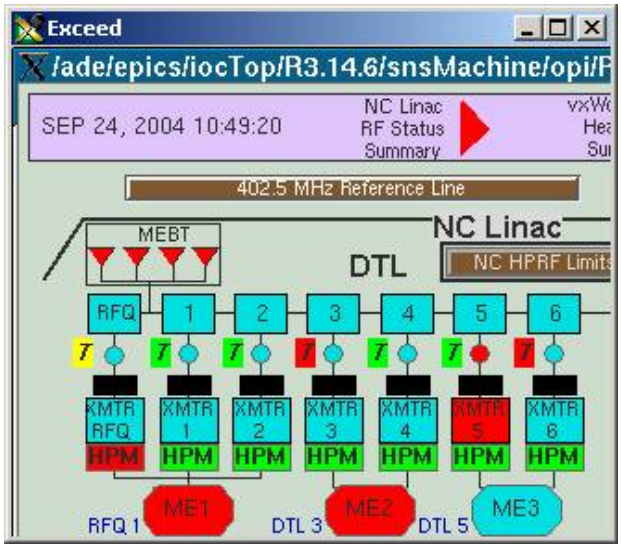
Work is underway to define budgets, plans and BA for FY05.

Controls

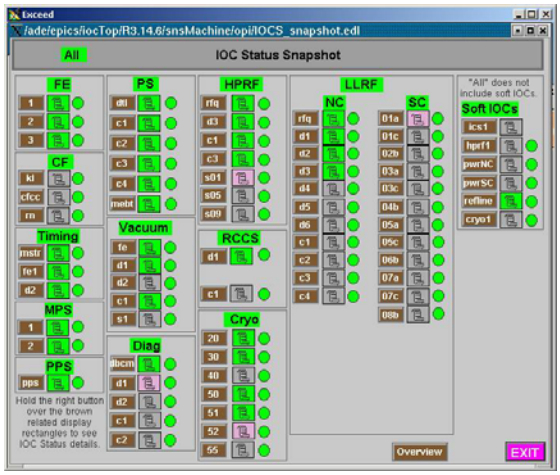
Support for the warm linac run continued this week. A memory upgrade was done on OPI2 in the Front End Control room. This console had frequently exhibited sluggish behavior which was found to be caused by memory depletion. The plot below shows the dramatic drop in memory use (and hence disc swapping) at 9:00 AM Thursday morning (9/23) when memory was added. At the same time on 9/20 memory use was between 80% and 95%. No way to run a ship.



New status bits were added to show that RF timing pulse delays are within the HVCM and LLRF timing pulses. In the screen shot below, the red T's mean the timing pulse is outside the LLRF pulse, the yellow T's mean the timing pulse is not centered inside the LLRF pulse or the rep rates don't agree and the green T's mean the rep rates agree and the timing pulse is nicely centered inside the LLRF pulse.



In response to an operational request, a new IOC status summary was created. (See below) Each green circle represents one IOC heartbeat. The brown related display buttons bring up other information for each IOC. The scroll icons are intended to be green when the corresponding IOCs are in operation, and they provide a quick way for controls engineers to enter a reboot into the controls e-log.

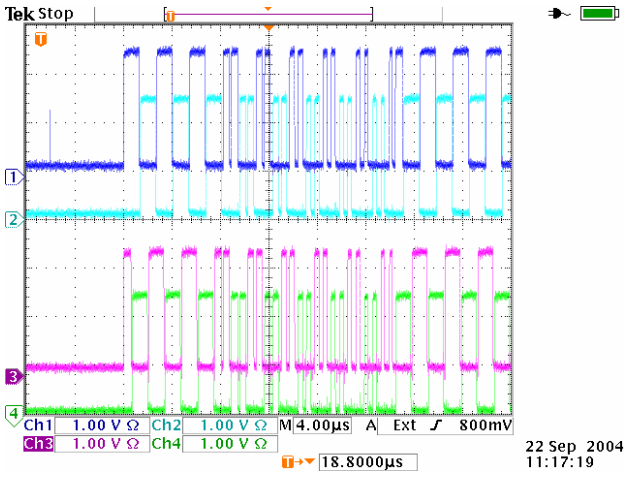


A number of other initiatives this week should help with operations. Screens to assist with rapid tuning of magnet currents and the RF amplitude and phase have been developed and require only linking to the top-level navigation screen. A power monitoring trend plot has been added, using the new set of archive viewing tools. Work continues on the Alarm Handler implementation for front end systems, and remote viewing of the LEBT RGA system has been implemented.

Improvements and bug-fixes are being made to the LLRF Frequency Control Module (FCM) as experience is gained. A slightly different resonance error computation had been added: Instead of directly fitting an exponential decay to the I+Q curves, there's now also a line-fit to the phase change during cavity decay. In theory, this is less good because of the nonlinearities involved in the atan(Q/I) transformation to get to the phase. In practice, however, the direct fit often fails for big resonance errors and rough manual estimates were required.

More seriously, it has been discovered that the FCM board seems to ignore certain "writes" to its registers. This has been observed using a backplane analyzer. This explains why LLRF systems sometimes start only half-initialized after a reboot, and may explain certain strange non-responses to button presses. These issues need to be resolved before further automation and be developed. Software has been implemented to report these errors. A crude initial work-around will be to write N times until the written value and the readback match. Again no way to run a ship.

Initial LEBT chopper tests have shown that because the input clock in the LBNL hardware design is not synchronized with the timing system, pulse to pulse jitter makes beam measurements difficult. (See scope traces below.) The 50 MHz free running clock has bee replaced with an event link ~68 MHz synchronous clock. The FPGA code needs to be modified to accommodate the new clock frequency. An evaluation board has been purchased for this effort with enough IO to input all our signals from the Timing system. The system should be ready for test next week.



Work continued on noise measurements and mitigation around the Ion Source. Work also started on an MPS test bed to help understand why MPS input channels go bad.

At BNL the SCL and HEBT BLM IOCs are being built up and will be shipped to ORNL early next week. The IOC-based feedback loop for the Ring RF is now working on the real cavity. At LANL, a heartbeat interlock reset issue in the DTL power supply system was resolved and fixed.

The controls team assisted in the factory acceptance test for Collimator Cooling Water Skids (CCWS) for the HEBT and Momentum dump. Photos attached show the skid (level switch on the head tank is shown on the right side) and the temperature control valve. Testing was successful. A few errors were found and they are being fixed. The vendor procured the wrong pressure sensor but the skid wiring was fine. The sensors were tested with 200 ft of cable to make sure the field cabling would be OK – it worked fine.

Installation

Craft Snapshot 9/14/04

ASD productive craft workers	**63.0**
Foremen (Pd by 15% OH)	5.0
AMSI management (Pd directly)	3.0
TOTAL AMSI WORKERS	71.0
Less WBS 1.9, 1.2 etc	**8.0**
Less absent	**5.0**
TOTAL PD BY ASD/ORNL DB WPs	**50.0**

Accelerator Physics

Five AP group members are giving ASAC presentations next week

Preliminary results have been obtained in a benchmark of the ORBIT code against analytic coasting-beam instability thresholds. Using the fully accumulated 1.44 MW beam momentum distribution, analytic coasting-beam instability diagrams have been obtained. Simulation of the same conditions with ORBIT give thresholds within 20% of the analytic thresholds, which is quite good agreement. Evaluation of instability thresholds with a new extraction kicker impedance estimate is underway, but expected to be quite similar to that obtained 1.5 years ago by Fedotov.

R. Campisi is attending a workshop at Argonne on RF field limits in pulsed superconducting cavities and materials.

Investigations into the best way to lower the elevation of the RTBT down to the elevation of the target show that it can be done in at least two different ways. One way is to offset QV15 and QV17 to provide the needed steering. Another way is to use the corrector magnets CDV15 and CDV17. The corrector magnet method eats up about half the available steering strength. Both methods provide a nice flat trajectory to the target.

Radiation model calculations for the end of the RTBT have resumed. They were on hold due to more urgent linac tunnel model calculations.

Operations

Ran Commissioning Activities

We began the week with difficulties maintaining the RFQ in stable operation.

The Ion Source failed with a water leak in an internal insulator and was replaced, but there was detectable water in the LEBT.

We could not bring the RFQ on line, it the two upstream windows would not hold voltage. We shorted the front windows and tried to operate the RFQ by feeding RF from the remaining 6 windows. We were not able to get the RFQ to a stable operating point in this configuration. We tried to replace the two bad windows with the two spares starting on Thursday maintenance day only to discover that one of the spares had gouged vacuum seals and a galled screw holding the center terminal connection. This was repaired and installed by Friday morning and pumped out by noon.

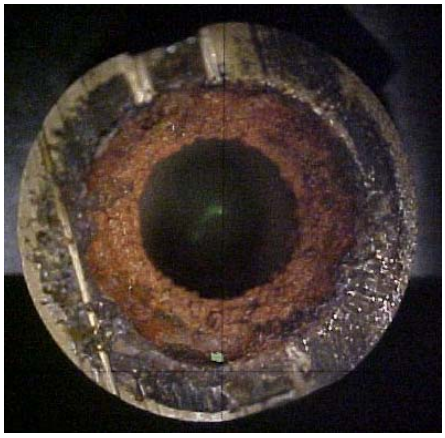
Target Operators are running shifts as Operator Trainees in the Control Room and we plan to certify them as Accelerator Operators

Taking a first look at Office Assignments for the November move to the CLO

Ion Source

A new ion source was started on the hot spare stand and emittances were measured with 30 and 40 mA. The source is currently producing 34 mA at 7.4% duty cycle, with very little decay. This record performance was achieved with Robert Welton's new conditioning and cesiation procedure that leaves the Cesium collar at room temperature until the cesiation process is started. Using HSC, a chemical thermodynamic equilibrium computer code, Robert found that when the cesium cartridges are hot, the Al and Zr getter reacts with reactive residual gases and therefore fails to reduce the Cs_2CrO_4 when desired.

Starting late on Sunday, corrosion inside the DI water loop created a 0.3 mm diameter pinhole. The pin hole developed in the 0.7 mm thick end flange of a ceramic break that is a part of the water loop cooling the electron target on the ion source extractor. The escaping water made the pumps fail. This leak, however, was hard to find because it was to small leave water residues in the LEBT chamber. After the water loop was replaced with a spare, $1 \cdot 10^{-6}$ Torr were reached after a few hours. The vacuum group identified the pinhole after the part was removed from the system. John Mashburn provided the two pictures taken with the optical comparator. The Front-end was equipped with a fully reconditioned ion source as a part of the troubleshooting effort.



Survey and Alignment

Mechanical

During the Thursday maintenance period, ion pumps which were suspect on DTL5 were replaced. MEBT diagnostics installations were accommodated as well on the maintenance day.

Due to the failure in a water line on the MEBT, the cryo pumps which are used for vacuum in the RFQ were shut down and purged to remove water vapor and pumped gasses.

It was decided upon examination and after attempts to run the RFQ that there were defective RF windows. Two windows were replaced on the RFQ, 2A and 2B. There were problems with the replacements which lengthened the down time but they were installed by noon on Friday. The RFQ drive lines have been re-tuned and it is now being slowly conditioned back to full power. The removed windows seem to have a heavy plating of some material. We will investigate what the material is and how it can be cleaned without damaging the windows.

Water Systems Installation

- Installation of the DI piping to SCL-ME7 continued.
- Piping to the ME04 HVCM and SCR cabinet was started.
- Installation of the SCL QMCS header was completed, system flushing will commence during the next maintenance period.
- Installation of the CLO Magnet Measurement Lab cooling lines continued.
- The FEB comm room AC unit was moved into position and piping to it will begin next week.
- An acceptance test and checkout was conducted at the vendor on the two HEBT collimator closed loop cooling systems.
- Installation continued on the RING SB power supply cooling system upgrade.

Ring Systems Installation

- The RING “C” arc has been pumped down to the same level as the other 3 arcs.
- Forms were installed on the RING arc Qtr-Cells in preparation for grouting.
- The storage areas in the RTBT were condensed and components staged in the straight sections relocated there.
- Two spare diagnostic chambers were crated and sent to storage.
- The diagnostic cable installation in the HEBT tunnel continued.
- A general cleanup was performed in preparation for next week’s ASAC tour.

Magnet Task

We have only two more 21Q40 assemblies left to install. Out of the eight, four are installed and two more are ready to go to the tunnel.

We are working on the SRF Warm Section Prototype. It should go to the tunnel Monday.

We have mapped a total of 18 – 8Q35's with ten being selected for installation

Work is progressing in our CLO Lab.

Electrical Group

Installed final 4000A, 18V power supply and an injection kicker magnet power supply in Ring Service Building.

Ken Rust visited IE Power in Toronto, Canada to observe first article testing for the 2500 A and 900 A power supplies. Final details of these tests will be available next week.

Installation:

- HEBT: Diagnostics, controls and vacuum terminations
- Linac Klystron Gallery: Terminations in SCL ME3, Cable pulls in SCL ME4, Rack installation in SCL ME5.
- Linac Tunnel: MB-8 terminations completed. MB-9 started.

Most of the group took a safety class in arc flash protection (NFPA70E) on 9/23/04.

SCL clean room ultrasonic cleaner installation and grounding

DTL-ME3 failed early in the week due to a shorted gate on one of the IGBTs. Fortunately, the over current detection circuitry shut the system down prior to any subsequent damage. The unit was brought back online, and the flux offset adjusted.

CCL-ME4 failed catastrophically on the C phase switch plate. The cause has yet to have been determined, but could be due to arcing on the harmonic traps installed on this unit. We will run a series of tests next week to determine the failure mechanism.

The HVCM in the RFTF failed due to MOV overheating (again). We have replaced the snubber resistors with a larger value to damp the oscillations at the time of current commutation. Additional measures may be necessary as we study this failure in more detail.

SCL-ME1 transformers were reconfigured for our retuning test of the SCL systems. They will be installed next week.

HPRF

All 92 klystrons are in the gallery.

SCL ME2 HPRF test are underway and should be finished in a day or two. We are capable of powering 24 MB cavities when connected.

Check out of CCL-4 Klystron, into shorted waveguide, has started hope to have it finished after ASAC
Starting to work in the SCL ME 3 area and hope to have all RF systems for all MB cavities checkout early November.

RFQ through CCL3 RF Systems supporting beam operations.

SCL ME2: High power testing into waveguide short > 350kW on all 12 klystrons. X-ray survey performed; results satisfactory.

SCL Klystron Gallery: All 28 HV klystron tanks and all 81 klystrons are in place.

RFTF: Cryo-coupler processing continues, 12 remaining to completion.

Preparing to begin installation of Ring RF equipment in the Ring Service Building

LLRF

Cryo Group

LN2 circuit in 2K Cold box leak checked and super insulated

Leak check of the Cold Compressors done for 3 out of 4 machines (10-8mbarl/sec background)

Leak check of the He process piping inside 2K Cold Box in progress

Manufacturing of the tunnel utubes continues at a rate of 1/day

Beam Diagnostics